



Labor Market Information and the Choice of Vocational Specialization

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Abstract—The choice of a vocational specialization at school is often hampered by the need for labor market information which is not available. This article investigates whether students of the Dutch junior secondary technical schools anticipate future labor market situations. We try to answer this question by introducing two extreme models: the cobweb model and the rational expectations model. By using the estimation results, the extent of the information problem is measured, indicating large mismatches due to unanticipated changes in the labor market. These results suggest the importance of additional public labor market forecasts to assist students' choices. [*JEL* I21, J24]

1. INTRODUCTION

THE DECISION to invest in human capital is a very difficult one. Human capital theory gives inadequate attention to the ways in which students form expectations about future labor market variables. From the human capital point of view, wages incorporate all the information relevant for the individual's investment decision, apart from individual preferences.

In the real world, however, students face two big problems in their decision to invest in their human capital. The first difficulty is the absence of information about wages that would reflect the value of their schooling at the moment they will enter the labor market. The wages that can be observed are present wages for present labor, which will certainly be an indication of future wages, but an imperfect indication. Lack of information may lead to imperfect anticipation. The most extreme effect of this discrepancy is described in the so-called "cobweb-theory", in which it is assumed that participants make no allowance at all for differences between the present labor market signals and the likely future situation.

A second difficulty arises because the labor market

is not, as assumed by the neo-classical theory, completely cleared by wages. In other words, wages do not reflect all relevant information. Thus, students need additional information to decide how to invest in their human capital.

It is of course important for students to anticipate future developments on the labor market as correctly as possible. The considerable difficulties which they face in forming adequate anticipations might create a need for medium-term forecasts of the labor market situation of various types of education (see, for example, Freeman, 1971, p. 229). Rosen (1987, p. 179) stresses the difficulties students face in expectation formation. He compares investments in human capital with other investments in buildings or production capacity and concludes that:

There is an important difference between the two. Business investment activities in the private sector are placed in the hands of a relatively small cadre of highly trained and highly skilled professionals. These people continually obtain market feedback on the wisdom of their judgments and repeatedly revise and revalue their decisions as new information comes available. Education decisions, on the other hand, are squarely in the hands of

young people and their parents. They are usually made at early stages of life, before the acquisition of significant practical experience, and do not continually occur.

There have been many attempts in the economic literature to measure students' response to labor market circumstances. Freeman (1971), Freeman (1975a), Freeman (1975b), Psacharopoulos (1973), Scott (1979), Hansen et al. (1980), Leffler and Lindsay (1981), Matilla (1982), Fiorito and Dauffenbach (1982), Siow (1984), Huffman and Orazem (1985), Zarkin (1985), Paulsen and Pogue (1988), and Stapleton (1989) measure the wage elasticity of enrollment in academic education by use of time-series. Tinbergen (1974) measures this elasticity by comparing different countries. Willis and Rosen (1979), Kodde (1985) and Whitfield and Wilson (1991) use individual data. The wage elasticity of enrollment found in these studies varies from roughly 0.5 to 2.0. Only a few studies also measure the elasticity with respect to the probability of getting a job. Freeman (1980) derives an elasticity, based on time series, of 0.29, while Kodde (1985) calculates an elasticity of 2.33 based on individual data. To be able to measure the enrollment elasticity, all these studies have to take into account the way students anticipate future developments of wages or employment opportunities. Most studies use, at least implicitly, cobweb or adaptive expectations. Only Siow (1984), Zarkin (1985), and Stapleton (1989) provide a model based on rational expectations.

Although both theories recognize the possibility of forecast errors, they have very different policy implications. In a cobweb model students make forecast errors due to their inability to forecast adequately, while in a rational expectations model students do predict all changes which are predictable given the data that is available. The latter model therefore leaves no place for a public forecast to assist students, since the professional forecaster can do no better than the student himself. The only exception to this is the possibility to provide more data to students. In that case it is not the forecast but the raw data which has additional value. In the cobweb model, however, it might be possible for a professional forecaster to improve students' forecasts, and thereby to improve the match between supply and demand on the labor market.

The choice of the expectation formation mechanism is, however, for most studies only a tool in order to be able to estimate the enrollment elasticities. Siow

(1984) tests the correctness of his rational expectations model, but Connelly (1989) has been able to reject this interpretation. Zarkin (1983) compares the cobweb model with the rational expectations model, but his preference for the rational expectations model is based on theoretical arguments. None of these studies leads to a measurement of the size of the disequilibria which occur due to wrong expectations, which might indicate the need for expert forecasts to help students in their educational choices. The only study which does measure the loss due to wrong expectations is Freebairn and Withers (1979). Based on surplus calculations they estimate a loss of 2% to 9% of income during the first 10 years at work. Their model is based on cobweb specifications from Freeman (1971) and Freeman (1975a), and again the correctness of this cobweb specification is simply assumed.

The aim of this article is to investigate, empirically, the use of labor market information by students, who are making a choice between alternative vocational specializations, and based on this to measure the extent of the disequilibria due to errors in their expectations. The focus in this study is on Dutch junior secondary technical education.¹ Junior secondary technical education is vocational, in contrast to all the studies mentioned above, which deal with academic studies. The vocational character of these schools enables us to assume that the various specializations that can be chosen lead to specific labor market segments. This implies that the decision to specialize is a crucial moment in the course. By specializing, a student excludes the alternative specializations. It is obvious that, even more than for most academic studies, the information problem in this situation is very important.

To investigate the information problem, we will measure, based on aggregated time-series, the extent to which the labor market situation plays a role in the choice of a vocational specialization. As noticed above, in a world in which markets are not cleared completely by wages, other aspects might also influence the allocation process. In this study two aspects will be taken into account: the wages and the probability of getting a job. In other words, the question is whether wages and unemployment in a certain market segment provide signals for students about the prospects of jobs, signals which regulate the coordination between demand and supply.

A second problem regarding the extent of the mismatch problems due to wrong expectations is how

students form these expectations. As mentioned above, economic theory about student choices provides us with two extreme positions, the cobweb model, propagated by the well-known models of Freeman, and the rational expectations model of, e.g., Siow (1984) and Zarkin (1985). In this article both models are tested and their hypotheses about expectation formation are tested.

Based on these tests and estimation results, which are in favor of the cobweb model, the number of students who made a wrong decision due to incorrect labor market anticipations is calculated. These numbers indicate the potential gains from public labor market forecasting. The question of the extent to which public forecasts could fill this expectation gap will not be taken into account. For this important question see, e.g., Ascher (1978), Ahamad and Blaug (1973), and Debreauvais and Psacharopoulos (1985).

The structure of this article is as follows. In the second section the information problem will be analyzed and a model will be formulated which describes the choice problem. Section 3 deals with the estimation procedure and section 4 provides the estimation results. In the fifth section the implications of these results will be investigated with respect to the possible gains from additional labor market information. Finally some conclusions are drawn.

2. THE PROBLEM OF INFORMATION

At Dutch junior secondary technical schools, students start with a general curriculum of two years (until 1970, this was one year). After this general course they have to make a choice of one of the two-year vocational specializations which the school offers.

Students are assumed to choose the specialization that will lead to the greatest welfare. That is, if we assume a utility function to exist, students will choose the alternative which delivers the greatest utility.

This utility will be influenced by the contents of the study (consumption effect) and improvements in their labor market position (investment effect). Students have to calculate all these effects in order to evaluate their utility function.

It is, of course, impossible to make such complex calculations. Hayek (1945, pp. 525–526) stresses this impossibility: "There is hardly anything that happens anywhere in the world that might not have an effect on the decision he ought to make". There are so many influences upon the utility that it is impossible to

evaluate them all. But from Hayek's point of view all relevant information will, nevertheless, reach the decision maker: "We must look at the price system as such a mechanism for communicating information...". Because of the market system, all relevant information, except for individual preferences, will be reflected in the price.

This means that, but for individual preferences, the choice between the specializations would be determined by the prices, i.e. the wages (and the direct costs of the human capital investment). Hayek's main assumption, however, is the existence of a perfect market and this assumption does not hold in the case of students' choices.

There are two main factors that violate the perfect market assumption. The first factor is that the labor market is not completely cleared by wages, which means that wages do not reflect all relevant information. There are other signals that also play a part in the allocation process, for example the unemployment and qualitative adjustments for job characteristics. In order to study the choice behavior of students, these factors should also be brought into the analysis.

The second factor that violates Hayek's assumption is that equilibrium prices that would contain all relevant information do not in fact exist. The only wages that can be observed are current wages, but these are not what students are looking for. The wages that are relevant for their decisions are the future wages, the wages prevailing during their working lives, and especially the wages in the year in which they enter the labor market. But futures markets generally do not exist on the labor market.

The only way to overcome this problem is to form an expectation of these future wages. The information problem then reappears in this calculation of expectations. In this imperfect situation, choices will be based on expectations rather than prices, and wages will not be the only relevant factor.

The formation of adequate expectations will therefore be rather difficult, and it is very likely that some people are better equipped than others to perform such forecasts. Students have to make such important decisions only a few times in their careers, and they are relatively young and unexperienced at the moment they have to choose between different specializations. It therefore seems not unlikely that the forecasts students are able to make might be considerably improved by using professional forecasts of the

future labor market situation of different specializations.

In this analysis, the specializations are clustered into three groups in order to integrate corresponding segments of the labor market and to avoid problems due to changing classification schemes over time, which would be encountered at a lower level of aggregation. These three specializations are: the building industry (*B*), metal industry (*M*) and food and catering industry (*F*).² The specific situation of these students, who have already invested one or two years in the general curriculum makes other alternatives (i.e. leaving school) relatively unattractive.

Figure 1 shows the changes in the numbers of students choosing one of these three specializations. The figure clearly shows that the total number of students has changed over time, and also that the distribution among the three specializations is far from constant.

These changing choices might, apart from changes in capabilities and the students' preferences, be explained by changes in the situation in the labor market segments that these specializations give access to. The basic assumption of this study is that students choose a specialization taking into account their preferences and the labor market prospects of vocational specializations. The distribution of preferences among students is not expected to change markedly, while the labor market situation might change rapidly.

One main argument in the choice is excluded from the analysis. That is attending a specialization in order to gain access to a higher type of education. Many schools have some kind of entry requirements, and a diploma in one of the three specializations might meet such requirements. Although the number of students from junior secondary technical schools who continue in full-time education after their final exam has

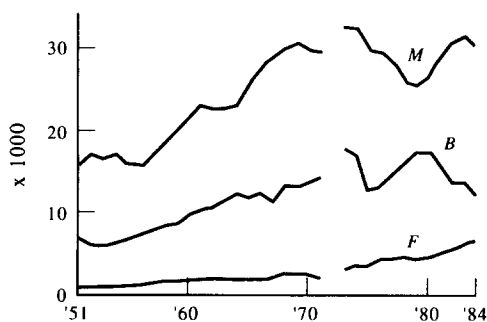


Figure 1. Enrollments over time in the three specializations.

recently become rather large, it is assumed that this argument does not play an important role in the choice of a specialization. The first reason for this assumption is that it is likely that students defer their decision to continue education until the final exam is near. Another reason to neglect this point is that students will generally continue their education in the same specialization, but at a higher level. The choice of a specialization is still made at the same moment; in fact only the length of the course, and therefore the year they will enter the labor market, will be different. Finally, in most years the number of students actually choosing further education is low. Thus the assumption will be made that it is the intention of all students to join the labor market at the end of this specialization course.

The individual decision depends on preferences, capabilities and the labor market situation. Because preferences and capabilities are given for one student, they are constants in the choice function of that individual student. The only variables in this individual choice function are related to the labor market situation. Because of the restricted data which is available, the labor market situation is represented only by wages and the probability of getting a job in the three specializations. Because students do not know these figures exactly, the choice function depends on their expectations of these figures, rather than the figures themselves.

Wages are measured by the total sum of wages in sectors of industry related to a particular specialization, divided by the number of people working in these sectors. The wages, defined this way, do not of course necessarily equal the wages of entrants, nor do they equal the present value of life-cycle incomes. However, since in The Netherlands most wages are regulated by collective labor agreements, which strongly determine the relationships between payments for the different age groups, the average wage at the moment of entrance might be viewed as a suitable indicator of the labor market situation of the occupation.

The probability of getting a job is defined by the number of people working in the relevant sectors, divided by the sum of the number of people working plus the number of unemployed with relevant occupations. Once again, these figures represent the situation for the whole occupational group, and at one particular time.

Because a choice has to be made between only a few alternatives, the individual choice function will

be characterized by some critical values. *Ceteris paribus*, a shift in a wage leads to a different choice at the moment the wage reaches the critical value. Because preferences are not equal for everyone, these critical values are distributed among the students.

On an aggregated level, this leads to a choice function in which the fraction of students choosing a certain specialization increases as the expected labor market prospects for that specialization improve. The better these labor market expectations, the more students will have passed their switching point.

The choice function is assumed to have the following form:

$$\left\{ \begin{array}{l} \frac{C_i^B}{C_i^M} = \alpha_1 \cdot ({}_tW_{t+2}^B)^{\pi_{11}} \cdot ({}_tP_{t+2}^B)^{\pi_{12}} \cdot ({}_tW_{t+2}^M)^{\pi_{13}} \\ \quad \cdot ({}_tP_{t+2}^M)^{\pi_{14}} \cdot ({}_tW_{t+2}^F)^{\pi_{15}} \cdot ({}_tP_{t+2}^F)^{\pi_{16}} \\ \frac{C_i^B}{C_i^F} = \alpha_2 \cdot ({}_tW_{t+2}^B)^{\pi_{21}} \cdot ({}_tP_{t+2}^B)^{\pi_{22}} \cdot ({}_tW_{t+2}^F)^{\pi_{23}} \\ \quad \cdot ({}_tP_{t+2}^F)^{\pi_{24}} \cdot ({}_tW_{t+2}^M)^{\pi_{25}} \cdot ({}_tP_{t+2}^M)^{\pi_{26}} \\ \frac{C_i^M}{C_i^F} = \alpha_3 \cdot ({}_tW_{t+2}^M)^{\pi_{31}} \cdot ({}_tP_{t+2}^M)^{\pi_{32}} \cdot ({}_tW_{t+2}^F)^{\pi_{33}} \\ \quad \cdot ({}_tP_{t+2}^F)^{\pi_{34}} \cdot ({}_tW_{t+2}^B)^{\pi_{35}} \cdot ({}_tP_{t+2}^B)^{\pi_{36}} \end{array} \right. \quad (2.1)$$

in which C_i^i is the number of students choosing specialization i ($i = B, M, F$), ${}_tW_{t+2}^i$ is the expectation, formed at t , of the wage at $t+2$, the moment the student will enter the labor market, related to specialization i , and ${}_tP_{t+2}^i$, similarly, is the expected probability of getting a job at $t+2$, formed at t , also for specialization i .

The ratio between the number of students choosing the building industry rather than the metal industry specialization also depends on the wage and probability of getting a job by enrolling for the food and catering specialization. A change in the labor market situation in the food and catering industry might have a differential impact on enrollments in the other two specializations, which might cause a change in the ratio.

By assuming that choices only depend on relative wages and relative probabilities (i.e. by assuming the "income-effect" to be absent), equation (2.1) can for estimation purposes be reduced to:

$$\left\{ \begin{array}{l} \frac{C_i^B}{C_i^M} = \alpha_1 \cdot \left(\frac{{}_tW_{t+2}^B}{{}_tW_{t+2}^M} \right)^{\beta_{11}} \cdot \left(\frac{{}_tP_{t+2}^B}{{}_tP_{t+2}^M} \right)^{\gamma_{11}} \\ \quad \cdot \left(\frac{{}_tW_{t+2}^B}{{}_tW_{t+2}^F} \right)^{\beta_{12}} \cdot \left(\frac{{}_tP_{t+2}^B}{{}_tP_{t+2}^F} \right)^{\gamma_{12}} \\ \frac{C_i^B}{C_i^F} = \alpha_2 \cdot \left(\frac{{}_tW_{t+2}^B}{{}_tW_{t+2}^F} \right)^{\beta_{21}} \cdot \left(\frac{{}_tP_{t+2}^B}{{}_tP_{t+2}^F} \right)^{\gamma_{21}} \\ \quad \cdot \left(\frac{{}_tW_{t+2}^B}{{}_tW_{t+2}^M} \right)^{\beta_{22}} \cdot \left(\frac{{}_tP_{t+2}^B}{{}_tP_{t+2}^M} \right)^{\gamma_{22}} \\ \frac{C_i^M}{C_i^F} = \alpha_3 \cdot \left(\frac{{}_tW_{t+2}^M}{{}_tW_{t+2}^F} \right)^{\beta_{31}} \cdot \left(\frac{{}_tP_{t+2}^M}{{}_tP_{t+2}^F} \right)^{\gamma_{31}} \\ \quad \cdot \left(\frac{{}_tW_{t+2}^M}{{}_tW_{t+2}^B} \right)^{\beta_{32}} \cdot \left(\frac{{}_tP_{t+2}^M}{{}_tP_{t+2}^B} \right)^{\gamma_{32}} \end{array} \right. \quad (2.2)$$

with

$$\left\{ \begin{array}{l} \pi_{i1} = \beta_{i1} + \beta_{i2} \\ \pi_{i2} = \gamma_{i1} + \gamma_{i2} \\ \pi_{i3} = -\beta_{i1} \\ \pi_{i4} = -\gamma_{i1} \\ \pi_{i5} = -\beta_{i2} \\ \pi_{i6} = -\gamma_{i2} \quad i=1,2,3 \end{array} \right. \quad (2.3)$$

The estimation will be based on this model with parameter restrictions, while the results will be presented in terms of model (2.1), which has a more convenient economic interpretation.

Choice function (2.1) provides a model of students' choices in which the choices they make are a function of the expectations they have about the future labor market situation. Finally, this model has to be completed with two alternative hypotheses about the way in which expectations are formed.

As was noted in the introduction, there are two schools of thought in the economic literature regarding students' choices. The first is the *cobweb theory*, which assumes that students base their decisions entirely on the present rather than on the future labor market situation. In other words, it is assumed that students expect the future situation to be similar to the present situation. Freeman is the most well-known propagator of this view.

The second school of thought is represented by Zarkin (1983) and Siow (1984). In their models, stu-

dents have *rational expectations* about the future labor market. The rational expectations theory assumes that students' expectations are the best possible expectations, given the data available at the moment choices have to be made.

The position of these two models can be interpreted as different views with respect to students' ability to forecast. Rational expectations assumes that if it is possible to forecast shifts in labor supply or demand students will indeed forecast this change. Students have a full capability to forecast, which is not dominated by any other forecast.

The cobweb theory, on the other hand, assumes that students have no capability at all to make such forecasts. While it might be possible to draw conclusions about future changes on the labor market given the current information, students do not know how to make such inferences. Their lack of insight in the functioning of the labor market makes it impossible for them to anticipate any change. The only way they can use labor market information is in its most direct form, as current wages or probabilities of getting a job. Without extra information, therefore, only information on the current labor market situation is available to students.

Summarizing, there are two extreme situations, the cobweb and the rational expectations theory. The cobweb theory assumes that students do not anticipate the future labor market situation and the rational expectations theory assumes that students anticipate the future situation as perfect as possible. These theories are extremes, so the truth might be somewhere in between.

3. THE ESTIMATION

In order to investigate the use of information, both the cobweb model and the rational expectations model will be estimated. The next step will be the comparison of the two models by an artificial nesting method. The analysis will determine the extent to which one model is able to explain the part of the data which is unexplained of the other model.

The first model to be estimated is the cobweb model. In equations (2.2), the expectation variables have to be replaced by present wages, which leads to:

$$\begin{cases} \frac{C_t^B}{C_t^M} = \alpha_1 \cdot \left(\frac{w_t^B}{w_t^M} \right)^{\beta_{11}} \cdot \left(\frac{p_t^B}{p_t^M} \right)^{\gamma_{11}} \\ \quad \cdot \left(\frac{w_t^B}{w_t^F} \right)^{\beta_{12}} \cdot \left(\frac{p_t^B}{p_t^F} \right)^{\gamma_{12}} \cdot t^{\delta_1} \\ \frac{C_t^B}{C_t^F} = \alpha_2 \cdot \left(\frac{w_t^B}{w_t^F} \right)^{\beta_{21}} \cdot \left(\frac{p_t^B}{p_t^F} \right)^{\gamma_{21}} \\ \quad \cdot \left(\frac{w_t^B}{w_t^M} \right)^{\beta_{22}} \cdot \left(\frac{p_t^B}{p_t^M} \right)^{\gamma_{22}} \cdot t^{\delta_2} \\ \frac{C_t^M}{C_t^F} = \alpha_3 \cdot \left(\frac{w_t^M}{w_t^F} \right)^{\beta_{31}} \cdot \left(\frac{p_t^M}{p_t^F} \right)^{\gamma_{31}} \\ \quad \cdot \left(\frac{w_t^M}{w_t^B} \right)^{\beta_{32}} \cdot \left(\frac{p_t^M}{p_t^B} \right)^{\gamma_{32}} \cdot t^{\delta_3} \end{cases} \quad (3.1)$$

In this model the choices are only influenced by predetermined quantities, so ordinary least squares can be used for the estimation. To get a linear equation, the logarithm of both sides of the equations is taken. In this three equation model, in fact, two equations determine all the parameters of the third. The use of ordinary least squares means that these parameter restrictions between the three equations will be automatically fulfilled. To allow for slow changes in preferences or the schooling system, a (multiplicative) trend variable (t) has been added.

The second model, with rational expectations, cannot be estimated directly by ordinary least squares, since the expectation variables are not observed directly. Rational expectations will, in general, differ from their future realizations. Rational expectations are only the best possible forecasts at a certain moment (t) of this future realization (at $t + 2$), given the information available at this moment (t). McCallum (1976) has shown, however, that it is possible to use the realization of the future variables as a proxy for expectations of these future variables. These proxies do, in that case, contain an error, which is the unpredictable part of the variable. But if the equation is estimated by use of instrumental variables which are known at the moment of forecasting, the estimation will be consistent. The Appendix provides details of this estimation procedure.

Finally, a comparison between the two models will be performed. The test is based on a regression of the predictions of both models on the true values of the choice ratios:

$$\frac{C_t^B}{C_t^M} = \text{CONST} + \Lambda \left(\frac{\hat{C}_t^B}{\hat{C}_t^M} \right)_{\text{Cobweb}} + (1 - \Lambda) \left(\frac{\hat{C}_t^B}{\hat{C}_t^M} \right)_{\text{RatExp}} \quad (3.2)$$

with

$$\Lambda = \frac{\lambda \sigma_{RatExp}^2}{(1-\lambda) \sigma_{Cobweb}^2 + \lambda \sigma_{RatExp}^2} \quad (3.3)$$

Equations (3.2) and (3.3) are based on a artificial nesting procedure (Fisher and McAleer, 1981), in which λ is the test-statistic for both hypotheses. Because the rational expectations model includes an unobserved forecasting error it will show a larger standard error than the cobweb model. Equation (3.3) corrects this difference.³

If the cobweb model is strictly better than the rational expectations model (i.e. the rational expectation predictions equal the cobweb predictions except for some noise not correlated with the real data), λ will be equal to 1. The other extreme is where λ equals 0. In this case the rational expectations model dominates the cobweb model. The absolute t -values indicate the additional information of the model, compared with the other model.

4. ESTIMATION RESULTS

Table 1 presents the estimation results of the cobweb model, based on equations (2.1). It contains six "triangles". Each triangle shows the effects of a change in wages or the probability of getting a job (vertically) in one of the three sectors (horizontally), leaving all other variables constant. For example, if the probability of getting a job in the building industry (first triangle of the second row) increases by 1%, the ratio of students choosing building industry specialization and students choosing the metal industry specialization increases by 2.72% (π_{12} in (2.1)). Significant effects are indicated by a bold arrow. The level of significance is 90%, which corresponds to an absolute t -value greater than 1.703.

All significant effects do have the correct sign. The significant arrows suggest that employment probabilities play an important role in the choice of the building industry specialization, while wages are most important for the metal industry and food and catering. The insignificance of the other parameters might be because these effects are rather small, or because the cobweb assumption about expectations does not hold.

Since it is difficult to interpret the parameters of Table 1, an example of the size of these results is presented in Table 2. In order to indicate the trend,

the predicted choices of 1951 and 1984 have been calculated as if there were no wages or employment probability differences between the vocational choices. Furthermore, the table presents the predicted choices in 1984, based on actual wages and probability figures, and the changes in this distribution for a 1% change of one of the six labor market variables.

Table 2 shows that the growth of the food and catering specialization is endogenous: the growth is not only caused by an increase in wages or probabilities of getting a job. From 1951 to 1984 this specialization grew, according to the model, 300%, even with no differences in wages and employment probabilities.

In 1984, the model predicts that the labor market situation caused 4956 students to leave the building industry in favor mainly of the metal specialization. The elasticities of supply vary, but accord with the general range found in similar studies. The maximum elasticity of supply with respect to wages is 2.9, in the food and catering industry, while for the probability of getting a job the elasticity is highest, at 2.2, in the building industry.

Table 3 shows the estimation results of the rational expectations model. Four out of the twelve labor market effects are significant. One of these, the ratio between building and food and catering industry, has the wrong sign.

Table 4 gives an example of the rational expectations estimation results, analogous to Table 2. As parameter restrictions are not necessarily fulfilled in the rational expectations model, the parameters of the third equation, the ratio of the numbers choosing the metal industry versus the food and catering industry, have been derived from the other two equations. In this model the maximum elasticity of supply with respect to wages is 5.5, again for food and catering, and 2.7 for the probability of getting a job, in the metal industry.

The fit of the two models has been indicated in Figures 2 and 3. They show the percentage of students in a certain year who did not choose the specialization which was predicted by the model. Although the differences between the estimation techniques mean that a comparison between the cobweb model and the rational expectations model is not completely justified, it is obvious that the rational expectations model fits less well than the cobweb model. It is, however, not possible to draw final conclusions from this observation.

In order to get an indication of the influence of

Table 1. Estimation with cobweb model (absolute *t*-values between brackets)

	Building industry	Metal industry	F & C industry
Wages	$ \begin{array}{c} B \\ \swarrow \quad \searrow \\ \pi_{11} = 0.31 \quad -\pi_{21} = 1.36 \\ (0.57) \quad (1.57) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $	$ \begin{array}{c} B \\ \swarrow \\ -\pi_{13} = 1.69 \\ (1.56) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $	$ \begin{array}{c} B \\ \swarrow \quad \searrow \\ -\pi_{23} = 2.33 \\ (2.04) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $
Probability to get a job	$ \begin{array}{c} B \\ \swarrow \quad \searrow \\ \pi_{12} = 2.72 \quad \pi_{22} = 4.55 \\ (4.23) \quad (4.40) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $	$ \begin{array}{c} B \\ \swarrow \\ -\pi_{14} = 1.87 \\ (0.67) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $	$ \begin{array}{c} B \\ \swarrow \quad \searrow \\ \pi_{24} = 1.43 \\ (0.36) \\ \swarrow \quad \searrow \\ M \quad \quad F \end{array} $
	Constant term	Trend	
B/M	-26.04 (4.48)	0.01 (4.44)	
B/F	18.53 (1.98)	-0.01 (1.87)	
M/F	44.58 (4.88)	-0.02 (4.73)	

the two hypotheses, the two extreme models will be compared. Zarkin (1983) mentions the difficulties of comparing these two models. A comparison of *R*-squared values will not suffice, because of the correlation of the explanatory variables of the two models. However, an artificial nesting test enables us to make a comparison.

Table 5 gives the results of this test between the models. The parameter λ , of equation (3.6) has been estimated for the three equations of the model. If the predictions of both the cobweb model and the rational expectation model are regressed on the real data, e.g. in the complete model of the building industry versus

food and catering, the cobweb predictions have a parameter value λ of 0.90 and the rational expectation model a $1-\lambda$ of 0.10. If this parameter was a 1, and therefore the parameter for the other model was 0, the model with a λ of 1 would, at the least, explain everything that is explained by the other model. The 0-parameter model might be rather good, but it would be completely eclipsed by the other model.

The table shows that in all cases the cobweb model has a higher parameter value than the rational expectations model, which implies that the cobweb model is a better description than the rational expectations model. $1-\lambda$ does not significantly differ from 0, and

Table 2. An example of the estimation results of the cobweb model (significant effects have been printed in bold type)

	Building	Metal	F&C
1951 (all wages and prob. equal)	7079	14628	1707
1984 (all wages and prob. equal)	18286	24623	5891
1984 (actual wages and prob.)	13330	29518	5952
change due to 1% rise of	+2	-84	+82
wage <i>B</i>			
wage <i>M</i>	-79	+326	-247
wage <i>F</i>	+73	-246	+173
probability <i>B</i>	+293	-156	-137
probability <i>M</i>	-247	-1	+248
probability <i>F</i>	-46	+149	-104

therefore λ does not significantly differ from 1. On the other hand, λ differs significantly from 0 at a 5% level ($t_{26,0.05}=1.706$) in only two of the three equations (B/M and B/F). These parameter estimates indicate that the performance of the cobweb model dominates that of the rational expectations model, although the *t*-tests indicate that the evidence is not very strong. This might be due to the relatively short time-series.

Overall, the analysis of this section shows that, in general, the cobweb model gives better estimation results, and also predicts better than the rational expectations model. The implication of accepting the cobweb hypothesis is that students do make systematic errors in their anticipations of the future labor market situation. These errors will lead to mismatches when the students enter the market. In the next section some simulations will show the extent of these mismatches.

5. IMPLICATIONS

Section 2 outlined two principal information problems which students face in choosing their vocational specialization at junior secondary technical schools. Firstly, there is a time-lag between the choice of specialization and labor market entry, and secondly, markets are not fully cleared by wages.

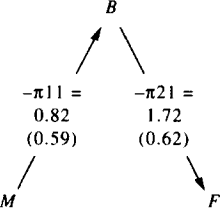
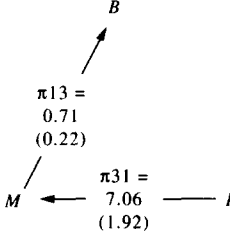
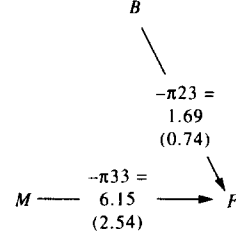
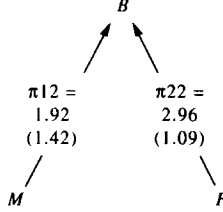
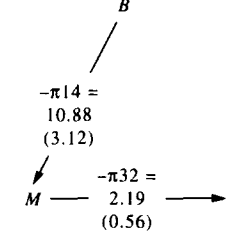
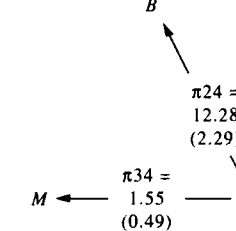
In this section the extent of this problem will be indicated using the estimation results of section 4. The results in this section are rather robust with respect to these estimates. As mentioned before, the extent of the mismatch due to cobweb behavior is an indication of the desirability of public labor market forecasts to help students to anticipate future developments. But this leads to the question of whether professional forecasters can improve students' expectations. This issue will not be taken into account.

In order to gauge the extent of the problem, a criterion for measurement is needed. The criterion used here is the number of students who (according to the estimated supply function) would have chosen another specialization if they had had full information on future labor market prospects. To measure this mismatch, the predicted enrollment for two (hypothetical) situations is calculated. Firstly, the predicted enrollment is based on actual labor market figures, according to the cobweb theory. Secondly, the enrollment is recalculated using the labor market figures at $t + 2$. This second enrollment indicates the hypothetical choice of students if they had known the future labor market situation. The difference between the two indicates the mismatch.

Three observations have to be made about this criterion. Firstly, it measures only aggregated, net effects. If one student chooses the metal instead of the building industry, but another student chooses the building instead of the metal industry, these effects will not appear in the aggregated supply functions of the previous sections. Secondly, the criterion does not take into account the fact that, if everybody had chosen the right specialization, the labor market situation would have been different. Finally, the criterion gives every mismatch equal weight, although there will be some students who made a wrong decision who were almost indifferent between the "right" and the "wrong" decision, while for others, the costs of a wrong decision might be rather high. In general, this will lead to an overestimation of small mismatches and an underestimation of large mismatches.

In the light of the results of the estimation in the last section, it is assumed that the cobweb model is correct. Thus, students' choices are completely determined by the present labor market situation. The

Table 3. Estimation of the rational expectations model (absolute *t*-values between brackets)

	Building industry	Metal industry	F & C industry
Wages			
Probability to get a job			
	Constant term	Trend	
B/M	-37.94 (2.54)	0.02 (2.52)	
B/F	10.24 (0.34)	-0.00 (0.32)	
M/F	50.34 (2.95)	-0.02 (2.90)	

extent of the mismatch is measured, based on the parameter estimations of the cobweb model.

Figure 4 shows the fractions of students who made the wrong decision, per year. The proportions of students making a wrong decision are rather high, especially in recent years: on average 3% of all the students at the junior secondary technical schools, but over the last ten years an average of 7%, rising to almost 16% in 1984.

Figures 5, 6, and 7 provide the same data for the three specializations separately. All three specializations show an increase in recent years, but the change is most radical in the building industry. In the food and catering specialization, some high mismatch percentages were found in the fifties.

The extent of the problem is far from equal for the three specializations. In the building industry the fraction making the "wrong" decision is 9% on average and as high as 49% in 1980, while the average in the metal industry is 4% with a maximum of 22% in 1984. The food and catering specialization also has its maximum in 1984, at 60%, but in this sector high mismatch rates also appeared in the fifties, with e.g. 27% in 1956. In this sector the average mismatch is 12%.

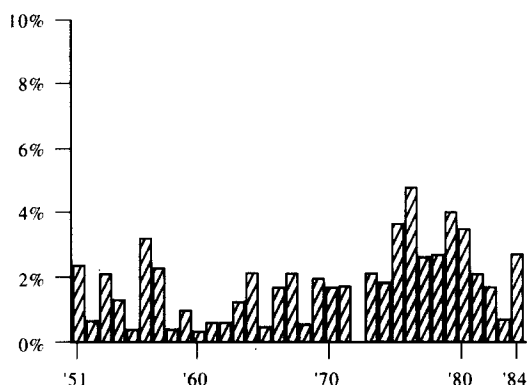
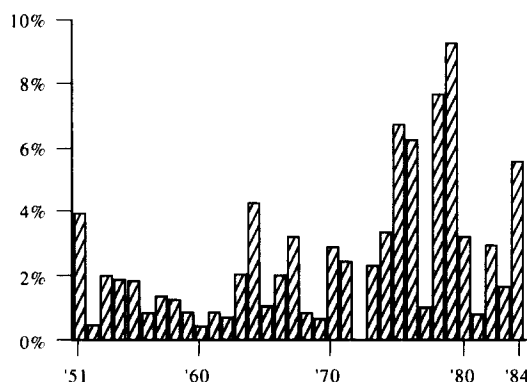
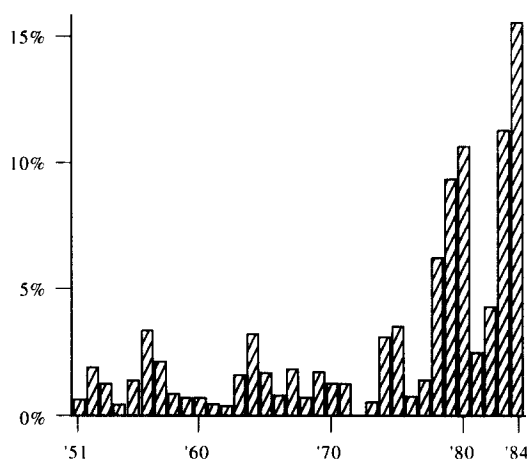
The mismatch fractions indicated in these figures might be seen as an indication for the value of correct information. If correct information was available this fraction of students would have chosen correctly, and thus this many students would be better off. Although it will not be possible for professional forecasters to

Table 4. An example of the estimation results of the rational expectations model (significant effects have been printed in bold type)

	Building	Metal	F&C
1951 (all wages and prob. equal)	5560	15754	2100
1984 (all wages and prob. equal)	16486	25030	7284
1984 (actual wages and prob.)	14702	28743	5355
change due to 1% rise of	-98	+42	+56
wage <i>B</i>			
wage <i>M</i>	+182	+152	-334
wage <i>F</i>	+90	-205	+295
probability <i>B</i>	+214	-137	-80
probability <i>M</i>	-1156	+770	+387
probability <i>F</i>	-985	+687	-298

Table 5. Comparison of cobweb and rational expectations model (*t*-value between brackets)

	<i>B/M</i>	<i>B/F</i>	<i>M/F</i>
λ	0.87 (1.77)	0.90 (1.77)	0.76 (1.33)
$1-\lambda$	0.13 (0.27)	0.10 (0.19)	0.24 (0.41)
<i>C</i>	-0.78 (34.00)	1.52 (28.57)	2.30 (35.89)

**Figure 2.** Misspecification of the cobweb model.**Figure 3.** Misspecification of the rational expectations model.**Figure 4.** The overall mismatch.

predict the future labor market situation perfectly, the measure of the potential value of correct information might be seen as the opportunity cost of not having better predictions.

In Figures 8 and 9, this "information value" is

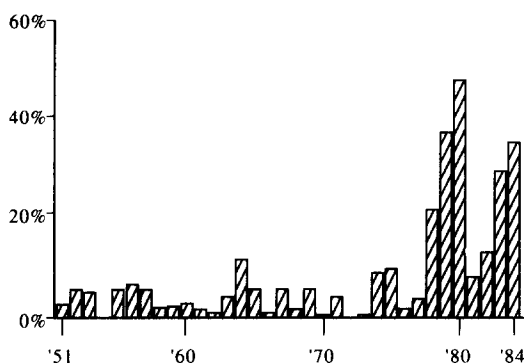


Figure 5. Mismatch in the building industry.

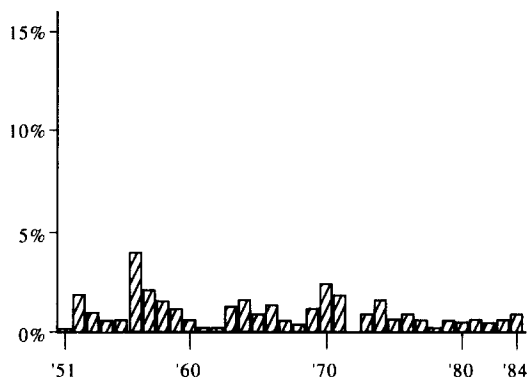


Figure 8. Value of information about wages.

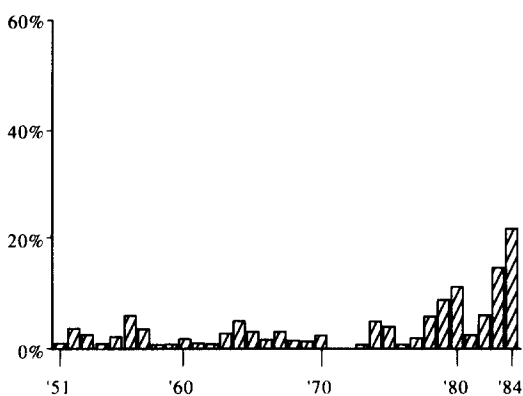


Figure 6. Mismatch in the metal industry.

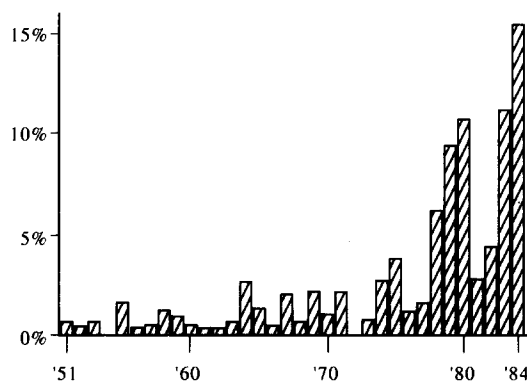


Figure 9. Value of information about the probability of getting a job.

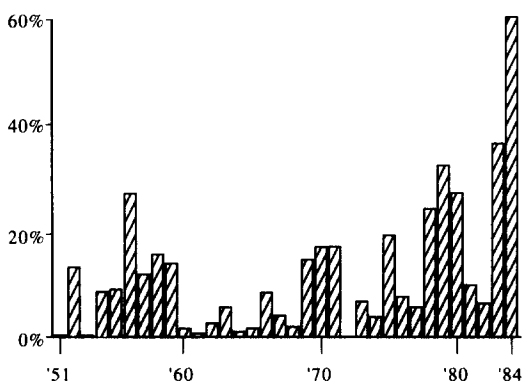


Figure 7. Mismatch in food and catering.

broken down into information about wages and about the probability of getting a job. The figures lead to two important conclusions. Firstly, the value of information about wages is decreasing, while the value of information about employment probabilities is increasing. Secondly, while the value of information about wages averages only 0.9% before 1972 and 0.4% after 1972, the value of information about the probability of getting a job averages 0.9% before 1972 and as much as 5.7% after 1972.

The decrease in the value of information about wages might be explained by the increasing rigidity of wages. If wages do not change much, the value of knowing future wages rather than present wages is not big. But this wage rigidity means that the fluctuations in the probability of getting a job have risen. If wages do not regulate the allocation process, the unemployment rate will take over this task. The

increase in the total mismatch might have two alternative explanations. Firstly, it might be that allocation performed by unemployment rates is more costly than allocation performed by wages, from an information point of view. Secondly, labor market fluctuations might have increased in recent years, so that the total costs have also increased.

6. CONCLUSIONS

The aim of this article has been to investigate the information problem which students are faced with when making a choice between alternative vocational specializations. On the one hand, the labor market is very complex, while on the other hand students who have to make their educational choice are rather unexperienced, and make such choices only a few times during their career. Such a situation might make it a desirable policy to assist students' choices by publishing detailed medium-term labor market forecasts of the labor market position of the various vocational specializations. Such forecasts will probably be most important for vocational courses which are closely connected to a specific labor market segment, and which therefore have a relative high risk of suffering from changes in the labor market situation.

Section 4 has shown that the labor market situation does indeed play a role in the choice of vocational specialization. These results are in accordance with other literature in this field. The estimation results showed that there does seem to be an influence, from both wages and the probability of getting a job, on students' choices. Table 2 shows that about 10% of the students in 1984 made a choice that differed from the notional choice had there been no differences in

wages or employment probabilities between the vocational specializations. The estimations indicate that the probability of getting a job is rather important for the building industry, while wages are a more important factor in choosing the metal industry and the food and catering specialization.

The question of whether students are able to anticipate future labor market changes seems to be answered negatively. We approached this question using two extreme models: the cobweb model and the rational expectations model. Both models have been estimated and a comparison has been made by means of an artificial nesting test. It is, however, difficult to draw clear conclusions from these tests. Most statistics seem to indicate better performance from the cobweb model, although the evidence is not very strong.

Finally we investigated the extent of the information problem, assuming that the cobweb model is the true model. The mismatch due to the information time-lag in this model was as high as 16% in 1984. The building industry specialization and the food and catering specialization are most affected by this problem. Another interesting conclusion is that the value of additional information about future wages is decreasing over time, while the value of information about the probability of getting a job has been increasing in recent years.

The mismatches measured are rather large. By providing good predictions about the future labor market situation, these mismatches might be remedied. The extent of the information problem calculated in this article indicates that, if it is possible to improve students' forecasts substantially, there would be a very valuable improvement in the relation between education and the labor market.

NOTES

1. In the Netherlands these schools are called LTS (Lower Technical School) and ITO (Individual Technical Education).
2. The data consists of figures about the number of students in the first year of specialisation, their wages and the probability of getting a job in the three economic sub-sectors (the building industry, metal industry and food and catering industry) from 1949 till 1986. Because the instruments contain a two-year lag, and because expectations must be formed of the situation two years in the future, the estimation is restricted to the period 1951 till 1984. The enrolment for 1972 is missing, due to the one-year extension of the general curriculum in 1971. In 1971, first-year students had to decide about their specialization, while the cohort of 1972 had to make this decision after their second year (in 1973). Simultaneously, the total length of the courses changed from three to four years, so the length of the specialization period has remained constant.
The figures have been taken from *The Statistics of the Junior Secondary Vocational Education, Monthly Bulletin of Socio-Economic Statistics* and *National Accounts*, published by the Netherlands Central Bureau of Statistics (C.B.S.).
3. λ is only identified in (4.6) if $\sigma_{Cobweb}^2, \sigma_{RatExp}^2$ are known. Since they are not known directly, they are replaced by their estimates, which is in fact incorrect because they may be estimates based on an

incorrect model. An incorrect model will, however, lead to an over-estimation of σ^2 , which will lead to a correction of λ in favor of the false model.

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APPENDIX: THE ESTIMATION OF THE RATIONAL EXPECTATIONS MODEL

The estimation of the rational expectations model is based upon the procedure of Cumby, Huizinga and Obstfeld (1983). Following McCallum (1976) they use realizations of future variables as proxies for the expectations. Therefore, equations (2.2) can be rewritten, including these proxies, as:

$$\left\{ \begin{array}{l} \frac{C_t^B}{C_t^M} = \alpha_1 \cdot \left(\frac{W_{t+2}^B}{W_{t+2}^M} \right)^{\beta_{11}} \cdot \left(\frac{P_{t+2}^B}{P_{t+2}^M} \right)^{\gamma_{11}} \\ \quad \cdot \left(\frac{W_{t+2}^B}{W_{t+2}^F} \right)^{\beta_{12}} \cdot \left(\frac{P_{t+2}^B}{P_{t+2}^F} \right)^{\gamma_{12}} \cdot t^{\delta_1} \\ \frac{C_t^B}{C_t^F} = \alpha_2 \cdot \left(\frac{W_{t+2}^B}{W_{t+2}^F} \right)^{\beta_{21}} \cdot \left(\frac{P_{t+2}^B}{P_{t+2}^F} \right)^{\gamma_{21}} \\ \quad \cdot \left(\frac{W_{t+2}^M}{W_{t+2}^F} \right)^{\beta_{22}} \cdot \left(\frac{P_{t+2}^M}{P_{t+2}^F} \right)^{\gamma_{22}} \cdot t^{\delta_2} \\ \frac{C_t^M}{C_t^F} = \alpha_3 \cdot \left(\frac{W_{t+2}^M}{W_{t+2}^F} \right)^{\beta_{31}} \cdot \left(\frac{P_{t+2}^M}{P_{t+2}^F} \right)^{\gamma_{31}} \\ \quad \cdot \left(\frac{W_{t+2}^B}{W_{t+2}^F} \right)^{\beta_{32}} \cdot \left(\frac{P_{t+2}^B}{P_{t+2}^F} \right)^{\gamma_{32}} \cdot t^{\delta_3} \end{array} \right. \quad (A.1)$$

By taking logarithms on both sides of the equation, the model becomes linear. An additive error term is added. This transformation implies implicitly that students' expectations are assumed to be rational in the sense that their expectation of the logarithm of e.g. the wage equals the expected value of the logarithm of the future wage. If the variance of the prediction errors are relatively small, this approximately equals a specification in which expectations are rational with respect to the wage itself. Which operationalisation is more correct depends on the form of students' (cardinal) utility function.

Because rational expectations are by definition the best possible expectations, the difference between these expectations and their realizations cannot be correlated with the expectations, so there has to be a correlation between this error-term and the proxy-variable (the realization). Furthermore, since the lag between the moment of choice and the entrance onto the labor market (which is 2 in this case) is more than one year, the periods of prediction are overlapping. This means that unpredictable events occurring in the overlapping year will be part of the error term in both years, which causes autocorrelation. Thus, the error term in this model is both autocorrelated and correlated with the proxy-variables. Using OLS in such a situation would lead to an estimation that is biased because of the correlation with the variables and not efficient because of the autocorrelation. Estimation with OLS would be consistent with the assumption of perfect foresight. The expectations are, in that case, assumed to be equal to the realization of wages and the probability of getting a job. According to the rational expectations theory, they are however only an approximation. Cumby, Huizinga and Obstfeld (1983) suggest an estimator for such models (a two-step two-stage least squares estimator), which is both efficient and unbiased. Nijman (1990) provides the formulas of the estimator in the linear model.

The model is estimated with lagged variables as instruments for endogenous variables, which are correlated with the error term, and this estimation is carried out twice. In the first step no autocorrelation is assumed, and in the second step autocorrelation estimates taken from the first step are used. A disadvantage of this procedure is that the parameter restrictions between the three equations will not be automatically fulfilled.

The wage and the probability of getting a job at moment t , $t-1$ and $t-2$ have been used as instruments for the expectations. Since these figures are assumed to be known at t , they do not, under the definition of rational expectations, correlate with the error-term, which includes the difference between expectation and realization.

The covariance-matrix Ω has been estimated using the residuals (e) of the first step 2SLS estimation. Because of the first-order autocorrelation (MA(1)) of the error term, and the gap in 1972, the covariance-matrix has the following structure:

$$\Omega = \begin{pmatrix} \sigma^2 & \rho & & & & \\ \rho & \sigma^2 & \rho & & & \\ & \ddots & \ddots & \ddots & & \\ & & \rho & \sigma^2 & 0 & \\ & & & 0 & \sigma^2 & \rho \\ & & & & \rho & \sigma^2 & \rho \\ & & & & & \ddots & \ddots & \ddots \\ & & & & & & \rho & \sigma^2 \end{pmatrix} \quad (A.2)$$

$\tilde{\Omega} = ee'$ provides data for estimating the parameters σ^2 , ρ , leading to an estimation of the covariance-matrix with the structure of (3.3) $\hat{\Omega}$.

Representing the right-hand variables of (A.1) by X , the left-hand variable by y , and the matrix of instruments by Z , the estimator of Cumby, Huizinga and Obstfeld (1983) becomes:

$$\hat{\theta}_{CHO} = (X'Z(Z'\hat{\Omega}Z)^{-1}Z'X)^{-1}X'Z(Z'\hat{\Omega}Z)^{-1}Z'y \quad (A.3)$$